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☒ original patent application,
() continuation-in-part application

INVENTOR(S): **Curtis Gregory Kelsay**

TITLE: **An Optical Interlink Between An Optical Transducer And Optical Data Port**

Enclosed are:

- (X) The Declaration and Power of Attorney. (X) signed () unsigned or partially signed
(X) 3 sheets of drawings (one set) () Associate Power of Attorney
() Form PTO-1449 () Information Disclosure Statement and Form PTO-1449
() Priority document(s) () Other (fee \$)

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PATENT APPLICATION
DOCKET NO. 10990356-1

**AN OPTICAL INTERLINK BETWEEN AN OPTICAL TRANSDUCER AND
OPTICAL DATA PORT**

INVENTORS:

Curtis Gregory Kelsay

AN OPTICAL INTERLINK BETWEEN AN OPTICAL TRANSDUCER AND OPTICAL DATA PORT

Background of the Invention

The advent of portable electronic devices, especially portable personal computers, such as laptops, notebooks and the like, has spurred a desire to transfer data from one device to another without having to physically connect the two devices. One example of this is printing a document to a printer from a notebook type computer. In the past, this could only be accomplished by attaching a cable between a serial or parallel port on the computer and a serial or parallel port on the printer. To eliminate this problem, manufacturers have turned to infra-red (IR) data transfer wherein each device is provided with an infra-red data port, which often include both an infra-red source and an infra-red detector or receiver.

One of the drawbacks to the current state of the art is that the "field of view" of the infra-red transducers is limited to approximately 30° , i.e. 15° on both sides of the axis. This places limitations on where the user can position the devices since the data ports must more or less line up. For instance, if the notebook computer's IR port is located on the back panel of the computer and the printer's IR port is located on the front panel of the printer, the computer must be placed generally in front of the printer to complete the data transfer. This can be a problem if there isn't enough available space on the table or desktop in front of the printer.

An additional problem, which is present in some electronic device designs, is a consequence of the limited available space within the electronic device itself. For instance, in most laser printers the majority of the space of the printer is utilized by the print engine and paper transport mechanism leaving little room for supporting electronics. The printed circuit assembly (PCA) is often mounted towards the rear of the printer to allow for the rear panel wire connection. With this location of the PCA, the IR transducer must be remotely located to provide front panel access.

In an effort to reduce the amount of desk space a peripheral such as a printer uses, the placement of the PCA within the peripheral may not allow the IR transducer proper external access. Prior to the present invention, the solution was to physically locate the IR transducer where it would have the necessary external access while providing the electrical connection to and from the PCA via a wire harness. Such approach increases the cost and potentially creates RFI problems.

Summary of the Invention

In order to accomplish the present invention there is provided an optical interlink which is made from an optical transducer capable of optically exchanging information. Information to and from the optical transducer passes through a light pipe transducer end and an optical data port end. The optical light pipe consists of separate transmit and a receive light pipes. To reduce losses as a result of the light pipe transmission, there is are lenses formed to collimate light between the transducer end of the light pipe and the optical transducer. The collimating lenses are formed in the light pipe. There are also provided additional lenses on the optical data port side of the light port. Transmitted light from the light pipe passes through a lens that increases the illumination angle of the light exiting from the optical data port. Received light passes through a lens that amplifies and collimates the light into the receiving light pipe.

Brief Description of the Drawings

A better understanding of the invention may be had from the consideration of the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a simplified internal view of a printer incorporating the present invention.

FIG. 2 shows the light pipe assembly in greater detail.

FIG. 3 shows the transmitting portion of the light assembly and its associated lenses.

FIG. 4 shows the receiving portion of the light assembly and its associated lenses.

Detailed Description Of The Preferred Embodiments

The present invention is not limited to a specific embodiment illustrated herein, in particular, while the preferred embodiment is shown as a printer, the present invention may be utilized by other equipment such as computers, facsimile machines, cameras, scanners, handheld devices, remote control devices, or data gathering devices. Referring particularly to Fig. 1 there is shown a printer 10 incorporating the present invention. Printer 10 includes many subsystems not shown but known by one skilled in the art. Shown within printer 10 is print engine 40, which is shown as a electrophotographic process (EP) mechanism. Other types of printing process could also be used. Paper enters the printer

from paper supply 20 and passes through print engine 40 where the desired image is placed on the paper. The paper then passes through fusing station 50 where the image is fused to the paper. Finally the paper exits printer 10 through opening 30.

PCA 60 includes numerous electronics which control the printing process.

5 Typically the electronics include things such as a microprocessor, memory, firmware, and I/O ports. Under the direction of the firmware or software, the microprocessor controls the printing process and communicates with external devices. As shown in FIG. 1 PCA supports two I/O ports. A direct wire port (61) is shown near the rear of the printer. This port is used to connect printer 10 to other devices such as a computer. Such a direct wired port is known in the art and may support one or more common configuration such as centronics,
10 bitronics, 1284, USB, or network. A second optical data port (64) is shown at the front of printer 10. This optical data port provides bi-directional wireless communication between the printer and other devices. The preferred embodiment use Infra-red light for the optical data port, but other types may be used with the present invention. The IR data port may use one or more protocol such as the Infra-Red Data Association (IRDA) protocol. The IR data port (64) is connected to IR transducer 62 by a pair of light pipes 63.

Referring next to FIG. 2 the light pipe assembly 63 is shown in greater detail. Light pipe 63 is constructed from two light pipes, one for transmit (70) and a second (71) for receive. Window 54 provides the optical interface to external devices. The transmit
15 light pipe optically connects the transmit portion of the IR transducer 62 to the window 54. In a similar manner, receive light pipe 71 optically connects window 54 to the receive portion of IR transducer 62. The light pipe can be made from several materials know in the art. In the preferred embodiment, the light pipe and lenses were formed from natural polycarbonate also known as GE Lexan 111N.
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FIG. 2 also shows a light guide 81. As is typical, printer 10 conveys
25 information to the user by way of a "READY" LED (80), while it is possible to mount LED 80 remotely from PCA 60, the use of a light guide or light pipe will allow the LED 80 to be mounted on the PCA. The light guide 81 transmits the LED light external of the printer. It should be understood that the light guide 81 is not necessary for proper operation of the IR
30 I/O.

Referring next to FIG. 3 where the transmit light pipe 70 is shown in greater detail. The transmit light pipe 70 is a constant cross section molded part with integral lens details on each end. Lens 83 collimates the light rays from the IR transducer for more efficient coupling and transmission through the light pipe. Lens 82 at the window increases

the angle of illumination of light exiting the window thereby creating an acceptable "viewing" angle distribution of the light rays as they exit the printer.

The receiving light pipe 71 is shown in FIG. 4. Receiving light pipe is also a constant cross section molded part with integral lens details on each end. Lens 90 is formed in the light pipe to collimate the light on to the receiving portion of the IR transducer. At the other end, receiving light pipe uses a lens to collect and thereby amplify the received light to help recover losses from transmission through the light pipe. FIG. 4 shows two lenses 91 and 92. Lens 92 is integral to the receive light pipe and can be formed as part of the molding process of the light pipe. Optional lens 91 could be formed during the molding of the plastic window 54. Optional lens 91 provides additional amplification and may provide improved performance of the IR data port.

One skilled in the art will understand that when designing the light pipes and lenses, several losses must be taken in to consideration. Some of these losses include Fresnel losses, surface scatter, and absorption losses. Fresnel losses are due to reflection at the entry and exit points. Surface losses are due to imperfect surface finishes and reflection of light off of these surfaces. Absorption losses are due to material properties of light pipe material for IR frequency light. Additionally, the light pipe should be designed to couple to the specific optical transducer. Ideally, the optical data port end of the transmit light pipe should have a similar "viewing" angle as the transducer. It may be desirable for the optical transducer to have a small viewing angle thereby increasing the amount of light coupled into the light pipe, while the optical data port lens creates a desired viewing angle to the external devices.

Although the preferred embodiment of the invention has been illustrated, and that form described, it is readily apparent to those skilled in the art that various modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

Claims

What is claimed is:

1. An optical interlink comprising:
a light pipe having a first end optically coupled to an optical transducer
and a second end arranged to provide an optical data port.

2. The optical interlink of claim 1 wherein the optical transducer capable
of transmitting and receiving information optically.

3. The optical interlink of claim 2 wherein the optical transducer uses
infra-red light to transmit and receive information.

4. The optical interlink of claim 1 wherein the light pipe further
comprising a receive light pipe and a transmit light pipe.

5. The optical interlink of claim 4 wherein the transmit light pipe further
comprising:
a first lens between the first end of the light pipe and the optical
transducer, the first formed to optically couple the optical transducer to the transmit
light pipe; and
a second lens placed to increase an angle of light exiting optical data
port.

6. The optical interlink of claim 5 wherein the first lens and second lens
being formed as part of the transmit light pipe.

7. The optical interlink of claim 4 wherein the receive light pipe further
comprising:
a first lens between the first end of the light pipe and the optical
transducer, the first lens formed to optically couple the optical transducer to the
receive light pipe; and
a second lens placed to collimate light received at the optical data
port into the second end of the light pipe.

1 8. The optical interlink of claim 7 wherein the first lens being formed as
2 part of the receive light pipe.

1 9. An optical interlink comprising:
2 an optical transducer capable of optically exchanging information;
3 a light pipe having a first end and a second end arranged to provide an
4 optical data port; and
5 a first lens formed to collimate light between the first end of the light
6 pipe and the optical transducer.

1 10. The optical interlink of claim 9 wherein the optical transducer uses
2 infra-red light to transmit and receive information

1 11. The optical interlink of claim 2 wherein the light pipe further
2 comprising a receive light pipe and a transmit light pipe.

1 12. The optical interlink of claim 2 wherein the light pipe further
2 comprising:
3 a transmit lens that increases an angle of illumination of light exiting
4 the optical data port; and
5 a receive lens that couples light incident on the optical data port into
6 the light pipe.

1 13. A printer comprising:
2 a print engine;
3 a controller connected to the print engine, the controller controlling
4 operation of the print engine, the controller including an optical transducer capable
5 of optically transmitting and receiving information; and
6 a light pipe having a first end optically coupled to the optical
7 transducer and a second end arranged to provide an optical data port.

1 14. The printer of claim 13 wherein the optical transducer uses infra-red
2 light to transmit and receive information.

1 15. The printer of claim 13 wherein the light pipe further comprising a
2 receive light pipe and a transmit light pipe.

1 16. The printer of claim 15 wherein the transmit light pipe further
2 comprising:
3 a first lens between the first end of the light pipe and the optical
4 transducer, the first formed to optically couple the optical transducer to the transmit
5 light pipe; and
6 a second lens placed to increase an angle of light exiting optical data
7 port.

1 17. The printer of claim 16 wherein the first lens and second lens being
2 formed as part of the transmit light pipe.

1 18. The printer of claim 15 wherein the receive light pipe further
2 comprising:
3 a first lens between the first end of the light pipe and the optical
4 transducer, the first formed to optically couple the optical transducer to the
5 receive light pipe; and
6 a second lens placed to collimate light received at the optical data
7 port into the second end of the light pipe.

1 19. The printer of claim 18 wherein the first lens being formed as part of
2 the receive light pipe.

ABSTRACT OF THE DISCLOSURE

An optical interlink made from an optical transducer capable of optically exchanging information. Information to and from the optical transducer passes through a light pipe transducer end and an optical data port end. The optical light pipe consists of separate transmit and a receive light pipes.

- 5 To reduce losses as a result of the light pipe transmission, there is are lenses formed to collimate light between the transducer end of the light pipe and the optical transducer. The collimating lenses are formed in the light pipe. There are also provided additional lenses on the optical data port side of the light port. Transmitted light from the light pipe passes through a lens that increases the
- 10 illumination angle of the light exiting from the optical data port. Received light passes through a lens that amplifies and collimates the light into the receiving light pipe.

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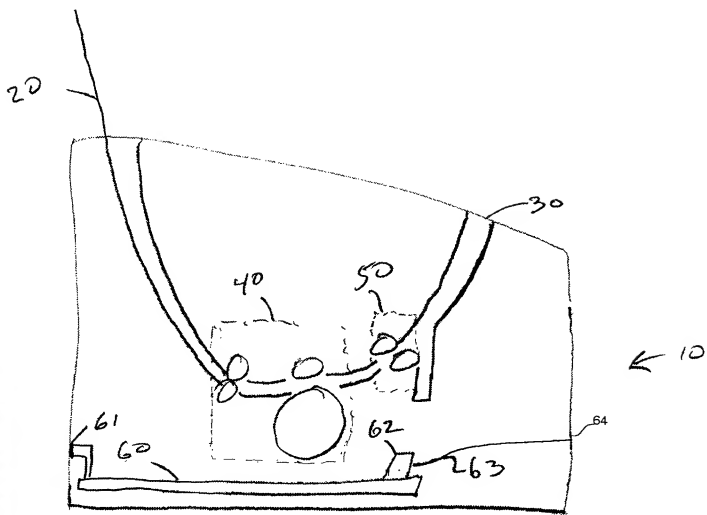
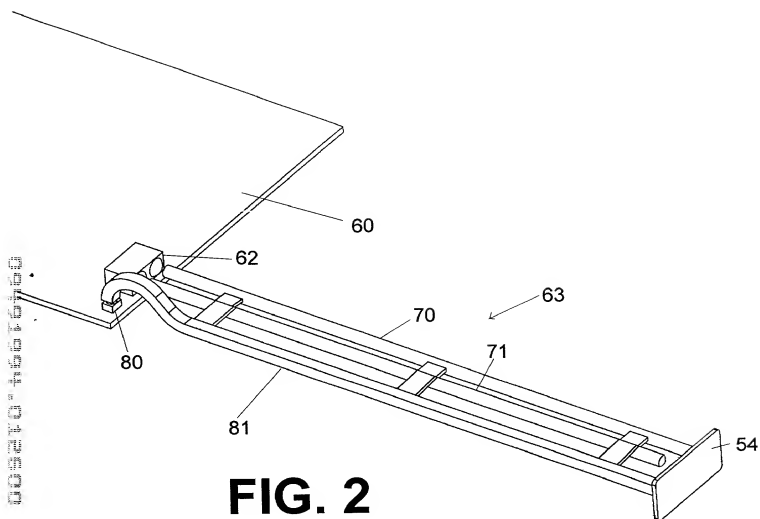


FIG. 1



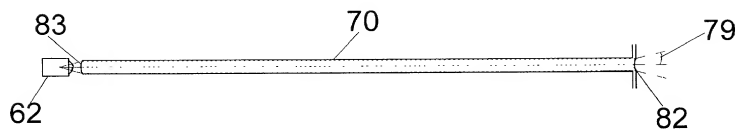


FIG. 3

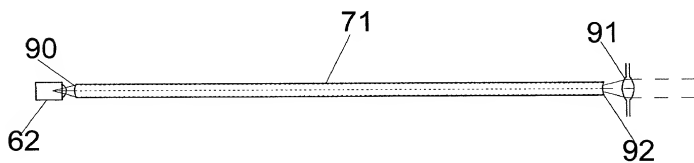


FIG. 4

DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATIONATTORNEY DOCKET NO. 10990356-1

As a below named inventor, I hereby declare that:

My residence/post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

An Optical Interlink Between An Optical Transducer And Optical Data Port

the specification of which is attached hereto unless the following box is checked:

() was filed on _____ as US Application Serial No. or PCT International Application Number _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understood the contents of the above-identified specification, including the claims, as amended by any amendment(s) referred to above. I acknowledge the duty to disclose all information which is material to patentability as defined in 37 CFR 1.56.

Foreign Application(s) and/or Claim of Foreign Priority

I hereby claim foreign priority benefits under Title 35, United States Code Section 119 of any foreign application(s) for patent or inventor(s) certificate listed below and have also identified below any foreign application for patent or inventor(s) certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NUMBER	DATE FILED	PRIORITY CLAIMED UNDER 35 U.S.C. 119
			YES: _____ NO: _____
			YES: _____ NO: _____

Provisional Application

I hereby claim the benefit under Title 35, United States Code Section 119(e) of any United States provisional application(s) listed below:

APPLICATION SERIAL NUMBER	FILING DATE

U. S. Priority Claim

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

APPLICATION SERIAL NUMBER	FILING DATE	STATUS (patented/pending/abandoned)

POWER OF ATTORNEY:

As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

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Number Bar Code
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Intellectual Property Administration
P.O. Box 272400
Fort Collins, Colorado 80528-9599

Direct Telephone Calls To:

Anthony J Baca
(208) 396-3597

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Inventor: Curtis Gregory KelsayCitizenship: U.S.Residence: 5437 Creswell Ave., Boise, ID 83703Post Office Address: Same as residence

Inventor's Signature

Curtis Gregory Kelsay

Date

1-24-2006